Monitoring volume transport in a branch of warm inflow towards the Arctic by satellite altimetry

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Norway

England

Nordic Seas

Arctic Ocean

Greenland

Atlantic Ocean

Greenland -Scotland Ridge

IPCC-2007: it is very likely that the North Atlantic MOC will slow down during the 21st century

North Atlantic MOC (THC)

IF-inflow: 3.5 Sv

>40% of total inflow
Monitoring the IF-inflow

4 CTD cruises a year since 1988

ADCPs since 1997
Recovering trawlprotected ADCP
The IF-inflow

Salinity

Velocity (cm/s)

Faroe slope

ADCPs

<34.90

>35.20

50 km

5 10 15 20

Faroe Islands
Monthly averaged volume transport

Monthly averaged volume transport

3.5 Sv
Measure volume transport and sea-level drop across the Ridge

Sea-level drop: SLHW - SLHE

Observations

Monthly correlation: $R = 0.63$

Annual correlation: $R = 0.87$
Why does the Atlantic inflow (continuously) cross the Iceland-Faroe Ridge
The main driving mechanism

Hansen et al. (2010): A simple model with Bernoulli + Coriolis, for periods > 1 day:

Volume transport = $\alpha \cdot \Delta h$
The new monitoring system

Remote sensing

Bottom temperature

To be tested within the NACLIM project
A proposal submitted to FP7
Discussion slides
Correlation coefficient between monthly sea-level height and IF-inflow: -0.4
T and S in the core of the IF-inflow
Local and Remote forcing

Remote wind forcing could raise sea-level west of the Ridge

R > 0

Atlantic Ocean

R < 0

Nordic Seas

Outflow from Nordic Seas tends to reduce sea level east of the Ridge by 30 cm/day

8.5 Sv out implies lowering of Nordic Seas SLH by 30 cm/day

Atlantic inflow

To Arctic Ocean

To Denmark Str.

IFR-overflow

FBC-overflow

Iceland Faroe Ridge

West

East
Most of the Atlantic inflow goes into the thermohaline loop

- Estuarine circulation: 2.5
- Atlantic inflow: 8.5
- Thermohaline circulation: 6.0
- Overflow: G.-S. Ridge
- Ventilation

70%
Annual mean surface temperature
Häkkinen & Rhines, 2004
Hátún et al., 2005

LS convection

SPG

STG
There is no indication that the oceanic heat transport towards the European Arctic has decreased. Perhaps, it has increased by ~ 10% since 1995.